Food and Nutrition

Need for Food:

Everything needs energy to do some job e.g. to operate machines, electricity, steam, fuels like coal, petrol, wood etc are burned to get energy. Similarly, living organisms require energy to carry out their diverse activities of life. They maintain the complex structure of cells, excrete waste material, and reproduce for continuation of their race. They grow in size during their life span as they are small when born and are large when adult. A considerable amount of energy is required to carry out the functions of life. The organisms, therefore, need to have some source of energy in order to maintain their life. Organisms get their energy from food. The type of food depends upon the kind of organism using the food. Some organisms use inorganic compounds to get their energy requirements. Some organisms use vegetables (plants) while some others require flesh (animals) as their food.

The organisms burn up their food (metabolize) to get a special form of energy called ATP (Adenosine triphosphate) which is used by them to carry out their functions of life.

Nutrients of Food and Their Importance:

The food of organisms and the organic compounds, building their bodies are almost same. Their bodies are composed of carbohydrates, proteins and fats etc. These substances are used by organisms as their food. They get energy from these substances. They use the components of food in growth and repairing of damaged tissues. Thus substances acquired by organisms to obtain energy are called nutrients and the process by which they are obtained is called nutrition. The food of all organisms which depends upon already prepared food has been found to consist of six basic components. These are as follows:

1. Carbohydrates

2. Proteins

3. Fats, Oils

4. Vitamins

5. Minerals

6. Water

Carbohydrates:

They are organic compounds. They are found in all organisms. They are commonly known as sugars. They contain three elements carbon, hydrogen and oxygen in which hydrogen and oxygen exists in 2:1 ratio that is why they are called hydrates of carbon or carbohydrates. One gram of carbohydrates provides 3800 calories of energy.

Forms of Carbohydrates:

Carbohydrates occur in three forms.

1. Monosaccharide

2. Disaccharides

3. Polysaccharides

Monosaccharides

Monosaccharides are simple sugars. Their common example is glucose. Glucose is main source of energy in our body cells.

Disaccharides

Disaccharides are formed by condensation of two monosaccharide units e.g. sucrose is formed by the combination of glucose and fructose. Maltose is another disaccharide.

Polysaccharides

Why many monosaccharides link together, they form polysaccharides. A single polyusaccharide may have many hundred units of monosaccharides. The common examples of polysaccharides are glycogen and starch. Glycogen occurs in animals and starch in plants. Another polysaccharide is cellulose, present in the cell walls of plants. It is the most abundantly occurring carbohydrate.

Sources of Carbohydrates

Carbohydrates containing starch are obtained from cereals and their products like wheat, rice, maize, oats and barley. They are also obtained from carrots, radish, turnip, beet, beet root and potatoes. Simple sugar called glucose is obtained from grapes. The sugar derived from fruit is called fructose. Then from beet and sugar cane is called sucrose and that from milk is lactose.

Importance of Carbohydrates in Human Body

One gram carbohydrate food provides 3800 calories to our body. The Carbohydrates are the cheapest and easy source of energy. Surplus carbohydrates are stored as glycogen in the liver and muscles, or converted to fats and stored in the fat cells beneath the skin and causes obesity.

Children, laborers and people, involved in physical labor need more carbohydrates in their daily diet whereas other should avoid them because their excess in the body can cause blood pressure, diabetes, obesity and heart diseases, therefore, carbohydrate products should be taken with care.

Proteins:

Proteins are very important organic compounds found in all organisms. Proteins contain carbon, hydrogen, oxygen and nitrogen and sometimes some amount of sulphur. There is no 2:1 ratio between hydrogen and oxygen. A protein molecule is composed of many building units linked together to form a chain. A chain of amino acids is called polypeptide. Amino acids are building units of a protein molecule. About twenty different amino acids occur in nature that combines in different manners to make different type of proteins. Proteins are structural part of the cell membrane. Some proteins are fibrous. They form different structures in the body like muscles, bones and skin. They also occur in our blood and cells. The enzymes which control different chemical reactions in the body are also proteins in nature. As a result of protein catabolism, energy is released. One gram of protein produces 4.3 kilo cal of energy which is used to synthesize ATP.

Amino Acids:

Plants can synthesize all the amino acids they need from carbohydrates, nitrates and sulphates but animals can not synthesize all amino acids. Amino acids are the building units of proteins.

There are about twenty different types of amino acids which are used in the synthesis of protein found in the human body.

Non-Essential Amino Acids

There are many amino acids which a human body can synthesize within the body. These are called non-essential amino acids.

Essential Amino Acids

There are approximately ten amino acids, which human beings cannot make. These are called essential amino acids and can be obtained directly from proteins in the diet.

Sources of Proteins:

Following are the sources of proteins:

Animal Sources e.g. meat, fish, chicken, milk and cheese.

Plant Sources e.g. legumes, pulses, dry fruit and cereals.

Importance of Proteins in Human Body

1. Proteins are essentially required for growth and development.

2. Growing children ,pregnant women and lactating mothers need a lot of proteins.

3. An adult requires 50-100 gms of proteins daily.

4. Protein deficiency in children and cause a disease called Kwashiorkor.

5. Proteins play an important role in the building of cellular protoplasm.

6. They also play an important role in the building of muscles and connective tissues.

7. Many proteins are required for making enzymes, hormones and antibodies.

8. If proteins are eaten in excess than needed by body, the excessive amino acids are converted into carbohydrates by the liver, which are either oxidized to release energy and converted into glycogen and fat and stored.

Fats and Oils:

They are also organic compounds found in plants, animals and humans. They are very important compounds made up of carbon, hydrogen and oxygen. Fats contain more carbon and hydrogen as compared to oxygen. A fat molecule has two parts, glycerol and fatty acids.

Fatty Acids

Different kinds of fats contain different fatty acids. Fatty acids are basically of followin two types:

1. Unsaturated Fatty Acids

2. Saturated Fatty Acids

Unsaturated fatty acids (molecules with one or more than one double bonds) are liquids at room temperature and are called oils. These are good for human health. Saturated fatty acids (molecules without double bond) are solid at room temperature and are called fat. They are not good for human health because they increase cholesterol level in the body. They cause narrowing of blood vessels which may result in heart attack.

Vegetable Sources

Vegetable fats are liquid and are called oils e.g. mustard oil, olive oil, coconut oil, corn oil. etc.

Animal Sources

Animal fats are solids e.g. butter, ghee and fatty meat.

Source of Energy

Fats and oils are rich source of energy they provide double energy as compared to carbohydrates and proteins. One gram of fat on oxidation releases 9.1 kilo cal of energy to make ATP.

Photosynthesis:

Photosynthesis is a Latin word derived from two words photo (light) synthesis (building up). In this process, green plants manufacture carbohydrates from carbon dioxide and water. The energy needed for this process is obtained from sunlight, which is absorbed by chlorophyll and oxygen is produced as by-product. Leaves are the major sites of photosynthesis in most plants but all green parts of a plant including green stems; un-ripened fruit can carry out photosynthesis. Temperature also plays a very important role in photosynthesis. Temperature affects the rate of photosynthesis. This process occurs during day time only.

Conditions and Factors Necessary for Photosynthesis:

Water

Plants need water for many functions of life. Water enters the root hair from the soil. It passes through various cells and reaches the xylem of the root. From here it moves to the stem and then the veins of the leaves. Finally, it reaches the mesophyll cells in the leaves. It provides hydrogen for the synthesis of glucose and helps in opening and closing of stomata. If leaves get less water, less stomata open, this reduces the rate of photosynthesis. Opening of more stomata provide more carbon dioxide for photosynthesis.

Carbon Dioxide

This is an important factor which affects photosynthesis. The amount of carbon dioxide in the atmosphere is about 0.03% and does not vary much. Its amount differs from place to place which may affect the rate of photosynthesis. e.g. the concentration of carbon dioxide close to the ground in a dense forest is higher than in an open field. Although carbon dioxide is needed in very little amount by the plants, yet photosynthesis cannot take place without it. It diffuses from the air into the intercellular spaces through stomata and enters the chloroplasts in the mesophyll cells. Carbon dioxide provides carbon to build up glucose molecule. If the amount of carbon

dioxide in the atmosphere increases to 1% rate of photosynthesis also increases, and it starts decreasing if concentration of carbon dioxide is decreased. If the concentration of carbon dioxide decreases below 0.03% the rate of photosynthesis also declines.

Chlorophyll

It is the green substance. It is found in special organelles called chloroplasts, which are found in the green leaves and herbaceous stems. In leaves, it is present in the mesophyll cells. Chlorophyll changes light energy into chemical energy and makes food in plants. Plants lacking chlorophyll cannot carry out photosynthesis occurs only in those parts where chlorophyll is present.

Sunlight

Light is very important for the process of photosynthesis. Without light the photosynthesis cannot take place. It provides energy needed for the synthesis of glucose molecule. Light intensity varies from day to day and from place to place. Plants photosynthesize faster on a bright sunny day than on a cloudy day. While light consists of seven colours. The blue and red are best for photosynthesis.

Is Chlorophyll Necessary for Photosynthesis?

Experiment

Since it is not possible to remove chlorophyll from a leaf without killing it, so it becomes necessary to use a leaf where chlorophyll is present only in patches. Such a leaf is known as variegated leaf and a plant with such leaves is used in this experiment.

For destarching the leaves, the pot is kept in a dark place for a couple of days and then exposed to day light for a few hours. The leaf is then removed from plant. Its outline is carefully drawn to note the position of presence or absence of chlorophyll on it.

Now iodine is applied to the leaf to test for the presence of starch (starch when ever comes in contact with iodine turns blue).

This test shows that only those parts which were prevously green turned blue with iodine while the white parts turned brown. This result indicates that starch is formed only in those parts of the leaf where chlorophyll exists (i.e. green parts). In other words photosynthesis is not possible without chlorophyll. If this were possible the white parts of the laf should have also given a blue colour with iodine.

Is Light Necessary for Photosynthesis?

Experiment

A potted plant is destarched by keeping it in the dark room for two days. It is then transferred to light. Two of its leaves are selected for the examination. One leaf is wrapped completely in black paper. The other leaf is also wrapped in black paper but an L-shaped part of the paper is cut out so that light can reach this part of the leaf through it. The plant is placed in the sunlight for 4 to 6 hours. The two leaves are now detached from the plant and tested for presence of starch. It would be observed that the leaf which does not receive any light is free of starch (remains brown with iodine). However, in the second leaf, light could pass through the L-shaped opening in the black paper. Only this L-shaped area turns dark blue while the other parts of the leaf remain brown. This shows that light plays a vital role in the manufacture of starch since starch is manufactured due to photosynthesis, light is essential for this process.

Is Carbon Dioxide Necessary for Photosynthesis?

Experiment

Two potted plants are destarched by keeping them in a dark room they are watered properly during this period. Each pot is enclosed in a transparent polythene bag as show in figure. A petri dish containing soda lime (potassium hydroxide) is placed on one of the pots to absorb any carbon dioxide present in the polythene bag. In the other pot a petri dish is placed containing sodium bi-carbonate solution which would produce carbon dioxide. The plants are then left in light for several hours. A leaf from each pot is detached and tested for starch. The leaf from the pot containing soda lime does not turn blue. soda lime had absorbed any carbon dioxide present in the bag. The leaf from the other pot where carbon dioxide was being released by the sodium bicarbonates solution turns blue indicating the presence of starch. These results show that carbon dioxide is essential for photosynthesis.

Nutrition in Man:

Like all other animals human beings need food for following activities:

1. To get energy this may be used to carry out different activities in the body.

2. To build new protoplasm in the cells, renew and replaced damaged cells and tissues for grwoth and reproduction.

3. To maintain health and build resistance against various diseases.

Man's diet consists of following components:

1. Carbohydrates

2. Proteins

3. Lipids

4. Vitamins

5. Mineral Salts

6. Water

Lipids:

Lipids are obtained from two sources:

Animal Sources

Ghee, butter, cream, animal fat and fish oil.

Plant Sources

Oils from mustard, olives, coconut, maize, soya beans, sunflower and peanuts.

Importance of Lipids:

1. The use of fat rich products increase in winters because they provide double the amount of energy as compared to carbohydrates.

2. They provide 9000 cal/gm energy to the body.

3. In plants fats are stored in seeds, and in animals, they are found beneath the skin and around the kidneys where they are not only stored but also protect these parts.

4. They provide materials for building new protoplasm and cell membrane.

5. Some fatty acids are essential for man.

6. Saturated fats (animal fats) should be used with, great care in our diet as they lead to rise in the cholesterol level, which accumulates in the blood vessels, and thus affects the flow of blood in the arteries This can result in heart attack.

Vitamins:

Vitamins are very complicated compounds. When vitamins were discovered, their chemical nature was not well known. Therefore, they were denoted with English letters as A, B, C, D, E

and K. Now it is known that vitamin B is not a single vitamin but a group of vitamins call ed as vitamin B complex. It has eight different compounds as B1, B2 etc although they have no energy value but they are essential in small quantities for the normal activities of life. It has been observed that when animals were given a diet rich in carbohydrates, fats and proteins but lacking vitamins, the growth and development of the organisms were affected and the animal suffered from various diseases. Vitamins are needed for healthy growth and development of the body. They also serve as enzyme.

Plants can prepare their vitamins from simple substances but animals obtain it directly or indirectly from plants. Fifteen or more vitamins have been isolated and most of them seem to act as essential part of coenzyme involved in chemical changes taking place in the body.

If our diet has variety and consists of fresh fruit and vegetables, our body will receive all those vitamins which are necessary for us.

Fat Soluble Vitamins

Some vitamins are fat-soluble and can be stored along with fat.

Water Soluble Vitamins

Some vitamins are water soluble and hence cannot be stored in the body, thus theirin take is required continuously.

Mineral Salts:

Mineral salts are inorganic compounds. They do not provide energy to the body. However, they are required for the normal chemical activities of the body. Man can obtain them from animals or plants which absorb them from the soil. Some minerals are needed by man and mammals in relatively large quantities, other are required in very small quantities.

Trace Elements

The mineral required by organisms in minute quantity are called Trace Elements.

Few Important Minerals

Calcium, Sodium, Potassium, Magnesium, Chlorine, Iron, Phosphorous and iodine etc.

Role of Minerals:

Sodium Chloride

It helps to make hydrochloric acid in the stomach which is very important for the digestion of food. Along with potassium it helps to conduct messages through nerves.

Potassium

It is found in the living cells especially in the red blood cells and muscles and it helps in the growth of the organism. The body acquires it through cereals.

Magnesium

It is an important component of the bones. It is obtained by eating different vegetables. It helps the enzymes which control different metabolic reaction.

Calcium

It plays an important role in strengthening the bones and teeth. It helps in blood clotting, muscular contraction and in the conduction of nerve impulse. It is found in milk, eggs, fruit, cereals and green leafy vegetables.

Iron

It is very important mineral. It helps in making hemoglobin in the red blood cells. It occurs in meat, liver, eggs, peanuts, spinach and other vegetables.

Flourine

It helps in the growth and development of the bones and teeth. If it is mixed in drinking water in suitable amounts, dental decay (caries) can be reduced in children. The body can obtain this mineral from vegetables and fish.

Note: In addition to these mineral trace elements like cobalt, manganese, zinc and copper are also necessary for the better health of the human body.

Role of Water:

Water:

Water makes approximately 70% of the body tissues. It is an essential component of the protoplasm. One can live without food for more than a week but a person can die within two to three days due to lack of water.

Importance of Water:

1. It plays an important role in digestion.

2. It helps in transport of digested food and other materials in dissolved form.

3. All the chemical reactions inside the cell take place in the presence of water.

4. It helps in excretion of urine, removal of faeces.

5. Enzymes become more active in solution form.

6. It keeps the blood thin and so that it can be easily circulated.

7. Water regulates the body temperature.

8. Its deficiency in tbe body causes dehydration, which can prove fatal.

9. Plants cannot photosynthesize without water.

10. The people living in hot and dry places need more water. By breathing, sweating and urination about 2-3 liters of water is lost per day.

Dietary Fiber (Roughage):

These are foods which provide fibers to our body.

Sources of Dietary Fibers:

All fruit and vegetables provide fibers to the body for example, citrus fruits, cereals, spinach, cabbage and salads. The cell wall in plant cells are largely made of cellulose which cannot be digested by man. Bacteria living in the gut of ruminants digest the cellulose and convert it into fatty acids, which renders it absorbable.

Importance of Dietary Fibers:

1. Roughage adds bulk to the food enabling the muscles of the alimentary canal to grip it and keeps the food moving by peristalsis.

2. Absence of roughage in our diet may lead to constipation and related disorders.

3. Fibers keep the intestines in a healthy condition, thus our daily diet must contain a lot of fruit and vegetables.

Nutrition and Food Technology:

For thousands of years, man has been making efforts to grow more food for storage so that it can be used when needed. Modern man knows how to preserve food for use subsequently when needed. Man has adopted modern techniques of food preservation in which its nutritional value and taste are preserved. Foods are damaged by bacteria; fungi and other micro-organisms, which occur everywhere. These organisms make food unsafe for use and storage, so it is necessary to kill bacteria or other organisms as soon as they enter food.

Early methods of preservation affected the taste of the preserved food, but modern scientific techniques prevent contamination of food, keep the taste and make it consumable even after a long period of storage. To achieve this, temperature plays an important role.

Food that we take is usually made up of dead tissue and it can be spoiled for two reasons, either the food is contaminated and destroyed by bacteria or fungi or the enzymes still active in tissue start breaking down the cells, thus making food poisonous and tasteless to eat.

All bacteria, fungi and micro-organisms must be killed or their growth must be retarded in order to protect the food from spoilage. Heat is the best source, as extreme increase in temperature retards bacterial growth and enzymes can also be denatured. Thus temperature extreme can be useful in the preservation of food.

Methods of Food Preservation:

Pasteurization

This method was discovered by famous biologist, Louis Pasteur. By this method milk is prevented from turning sour. In this process, milk is heated to 71 C for a few seconds and then cooled rapidly. This kills most of the bacteria. The bacteria which survive this treatment may become retarded in growth. In this way, the milk is preserved for a few days.

Refrigeration

In this methods, food is kept at very low temperature usually below freezing point. It retards the action of enzymes and the growth of bacteria. In deep freezers food can be preserved for many years. Quick freezing helps to maintain the taste and texture of meat, fruit and vegetables.

Dehydration

In this method food is dried. Such food can be kept safe for a long period at normal temperature. Bacteria do not grow without water, therefore when water content is removed from meat and vegetables, they can be preserved for long durations. Pickling of food is another common indigenous technology in which taste and texture of pickled food is maintained for long.

Canning

In this method the food is first heated at a high temperature. This kills bacteria and destroys enzymes. Then, the food is sealed in a metallic container. In this way; food becomes safe from contamination. Metallic cans are usually lacquered to prevent food from chemically reacting with metals and producing toxic substances.

Health Problems Related to Nutrition:

Under Nutrition

During under nutrition a person's diet is deficient in the required calories. children are mostly affected due to availability of less than normally required diet and they suffer from a disease called marasmus. In this disease, children are reduced to a skeleton as the body becomes completely depleted. Some of the countries like Ethiopia are famine stricken. Although international community does try its best to rescue the famine inflicted areas yet it is not possible for them to meet their complete nutritional requirements on such a large scale. The world population is continuously and rapidly increasing each year. It has been estimated that by 2025, the world population will rise to ten billion, whereas water and soil resources are being continuously depleted by increasing use by the continuously growing population. The experts therefore envisage that increasing human population if not checked will soon eat up all the food resources of the world which may lead to destruction of human race.

Malnutrition

If malnutrition (a diet missing in one or more essential nutrients) continues for a prolonged period, particularly under special circumstances, such as during pregnancy or immediately after childbirth, it is found to be very harmful.

If malnutrition occurs during lactation period, it causes irrepairable damage to the infant. During the last quarter of pregnancy when foetus is rapidly developing its cerebral tissues, the protein deficient diet of the mother results in mental retardness and nervous abnormalities in foetus, which may prove fatal or lead to permanent disorders. These abnormalities may also occur in infants if the lactating mother is taking a protein deficient diet during the first year of breast-feeding.

If a human diet lacks essential elements or nutrients, the body will fail to prepare vital compounds, and thus the person will suffer from various diseases. Deficiency of a few amino acids, vitamins, fatty acids (about thirty compounds) and 21 mineral elements, called as essential nutrients in diet are responsible for various diseases.

In the poor countries like ours packaged or junk food(sugar coated cumin seeds, betal nuts, chewing gums and drinks) are not prepared under proper care. The food colours scents and flavours are added to make them commercially attractive. But these are substandard and harmful

for human health. The use of food additives may be the cause of dangerous diseases like cancer and ulcer etc. These items should, therefore, be avoided.

Over Nutrition

It is the problem of the developed countries where people eat too much. Obesity is the most common disorder due to over nutrition. Obesity is the cause of a large number of diseases too.

Balanced Diet:

A diet containing essential dietary components in the correct proportion, which helps to maintain health and fulfills the body requirements of organisms, is known as balanced diet. The degree to which any particular meal is adequate in providing energy from food depends on the nature of the job of a person.

A common man's diet is said to be suitable if it provides 50% calories from carbohydrates, 40% from fats, and 10% from proteins. Carbohydrates are abundantly used foods because they are readily available and cheaper as compared to fats and proteins. We can live without carbohydrates it our diet has all the components of food and is capable to provide total calories required by the body. Fats are taken in our diet to obtain energy. Our daily food requirement varies with sex, age and occupation e.g. children need more food because they are growing. Youth need more food than elderly people due to physical exertion. Men need more food than women. Pregnant women, lactating mother's convalescents need more food as compared to others.

Teeth:

God has blessed animals and human beings with teeth. They help in breaking and chewing of the food. They are present in oral cavity.Teeth are attached to the upper and lower jaws.

Kinds of Teeth:

Humans have two sets of teeth during their lives.

Milk Teeth:

The first set of teeth begins to come through the gums when the baby is about six months old. these are called the milk teeth and all twenty teeth are formed over a period of two years.

Permanent Teeth

The milk teeth begin to drop out at the age of six years and are gradually replaced by the second set of teeth called the permanent teeth. In man the milk teeth do not fall off simultaneously, they fall off one by one and similarly permanent grow one by one as well. Healthy teeth are strong and give a beautiful and lustrous look. You must brush your teeth at least twice a day.

Structure of a Tooth

A tooth has two permanent parts, the Crown and the Root. The crown is that part of tooth which projects out of the gum and jaws. The root the the tooth is embedded into the gums and is therefore, hidden.

Enamel

This is the outer most part of tooth which is very hard and lustrous. It is deposited on the outside of the crown of the tooth by cells in the gum. The enamel is a non-living substance. It is made up of calcium salts. It imparts beauty to the tooth and protects the tooth. If the enamel gets removed then the teeth start decaying.

Dentine

It is the part of teeth present under the enamel which is hard. But it wears off if the enamel gets removed. Running through the dentine are strands of cytoplasm arising from the cells in the pulp. These cells keep on adding more dentine to the inside of the tooth.

Pulp

The innermost part of the tooth is hollow and is made up of soft connective tissue which is called the pulp. The strands of cytoplasm in the dentine derive their food and oxygen from the pulp which enables the tooth to live and grow. The pulp contains sensory nerves and blood capillaries. These nerve endings are sensitive to heat and cold and can produce the sense of pain e.g. toothache.

Cement

Cement is a thin layer of very hard material which covers the dentine at the root of the tooth. the fibers holding the tooth in the jaw are embedded in the cement at one end and in the jaw at the other. In this way teeth remain firmly embedded in the jaws.

Protection and Cleanliness of Teeth:

Teeth are a gift of nature. For a good health, presence of clean, good healthy teeth is necessary if we wish our teeth to remain healthy; we should wash and clean them after every meal. Our

tongue helps in cleansing the upper portion of teeth to some extent. If food particles are firmly trapped up between the teeth, or between gums and teeth, then it becomes difficult to remove them with the tongue. The main cause of tooth decay is a sugar coating left by sugary food on the teeth, which is converted into acid by bacteria. The acid damages the enamel and allows the bacteria to infect the soft dentine and reach the pulp cavity. The dentine begins to decay and causes toothache. Sugary foods such as sweets, toffees and chocolates, the bacteria which cause decay, form a thin layer of scum over the surface of the teeth. This layer becomes very hard with the passage of time and becomes difficult to remove. This scum is called plaque.

The teeth should be cleansed properly and regularly with a miswaak or a tooth brush. So that there is no formation of plaque. We should eat less sugar or sweet and sticky foods and also cleanse the teeth afterwards. Balanced diet should be taken, especially by young people who have growing teeth.

Digestion of Food:

First of all food comes in the oral cavity where the teeth crush and break the food and convert it into small particles. The tongue rolls the morsel of food and pushes it under teeth again and again so that the food is evenly divided into fine particles and the saliva secreted from the salivary glands gets mixed with the food. The saliva lubricates the food and makes the particles adhere to one another, forming a ball of food called bolus. Now the chemical digestion of food begins. Saliva contains an enzyme to digest starch in the food. The combined action of teeth, tongue and saliva pushes the bolus through the throat into the oesophagus, and then it reaches the stomach.

Definition of Digestion:

Digestion is the process in which the insoluble and non-diffusible components of food are broken down and by the action of enzymes are converted into soluble and diffusible substance to be absorbed into the blood stream.

Types of Digestion:

1. Mechanical digestion

2. Chemical Digestion

Mechanical Digestion

In mechanical digestion, the food consisting of large sized particle is broken into fine pieces by cutting, grinding, chewing and churning up, so that enzymes can act upon it efficiently and effectively. Mechanical digestion of food takes place in the mouth and stomach.

Chemical Digestion

In chemical digestion, the digestive enzymes mix with the food and act upon it to break it down further into simple and diffusible chemical forms. The enzymes act on carbohydrates, proteins and fats separately. Chemical digestion takes place in all the major parts of the digestive system. The digestive glands such as liver and pancreas also play very important role in this digestion.

Digestive System:

All living things require food to live and carry on their life functions. Animals are unable to synthesize their food.

Digestion is the process in which the non-diffusible molecules of food are changed to diffusible ones by the action of enzymes. All the organs which take part in this process make a system which is called the digestive system.

Human Digestive System:

The process of digestion takes place in the alimentary canal. It starts from the mouth and ends at the anus. The tube assumes different shapes according to their role in the process of digestion. It consists of the mouth, oesophagus, stomach, small intestine, and large intestine. Besides these organs liver and pancreas, also play important roles in digestion.

Peristalsis

The muscles of alimentary canal produce rhythmic waves of contraction which is called peristalsis. Due to this process, food is carried through various parts of the alimentary canal.

Ingestion

The food of animals and human is in the solid form and may be bulky. Taking in of the food in the oral cavity and swallowing is called ingestion.

Digestion of Food in the Mouth:

During mastication, the food is mixed thorougly with the saliva while the food is in the oral cavity (buccal cavity). The saliva is secreted by three pairs of salivary glands located in the buccal cavity. The saliva is continuously secreted by the salivary glands in response to the presence of food in the buccal cavity.

Saliva is alkaline and contains an enzyme ptyalin. This enzyme converts starch into sugar (maltose). The morsel of food after being chewed and thoroughly mixed with the saliva is called a bolus. It is rolled down by the swallowing action into the oesophagus which conveys it to the stomach by the wave of peristalsis. The end of stomach lined with oesophagus is called cardiac end.

Digestion of Food in the Stomach:

Stomach is a thick sac like structure, in which food is stored for some time. Its wall is strong and muscular. Its inner surface has numerous glands called gastric glands. These glands secrete a juice called gastric juice. Human stomach secretes about one to two liters of this juice daily; Gastric juice contains Hydrochloric acid and two enzymes, renin and pepsin. Hydrochlroic acid changes the medium of food to acidic. This medium kills the bacteria that may be found in the food. the pepsin acts on proteins and breaks them down into peptones. Renin helps to curdle milk in infants. There is no chemical action on carbohydrates and fats present in food. the regular movements of the stomach churn up the food. the food is changed into a thick fluid called chyme. When digestion in the stomach is complete, the distal end of the stomach called the pyloric end relaxes, and allows a small amount of chyme to pass into the first part of the small intestine. Food stays in stomach for about 2-3 or 3-4 hours.

Digestion of Food in the Small Intestine:

Food from stomach enters the duodenum which is the first part of the small intestine. An alkaline pancreatic juice from the pancreas and bile juice from the liver and poured into the duodenum by a common duct. Both the juices contain bicarbonates which neutralize the acidic chyme and make. It rather alkaline besides these juices other intestinal juices from the walls of the small intestine are also poured. These entire juices act on food and help in digestion of food.

Liver:

It is largest gland, in the body. Its colour is reddish brown. It lies just below the diaphragm on the right side of the body under the ribs. It has five lobes, three on the right side and two on the left. The cells of the liver secrete a greenish yellow alkaline fluid which is called the bile juice. It

contains bile salts and bile pigments which give greenish yellow colour to the juice. Bile contains no digestive enzymes, but it does contain bile salts which break down the large molecules of fats to small fat droplets. This process is called emulsification. This process helps in the digestion of fats. Bile juice also contains bile pigments that are by products of red blood cells, these pigments are eliminated from the body along with the faeces, and the colour of faeces is due to these pigments. Besides this, bile juice also kill the germs in the food.

Functions of Liver:

1. Liver stores glycogen and regulates the level of glucose in the blood.

2. It breaks down excess amino acids. this process is called deamination.

3. It is involved in detoxification.

4. It produces and secretes bile juice which is stored in the gall bladder.

5. It metabolizes carbohydrates, fats, proteins and other compounds.

6. As a result of chemical changes a lot of heat is produced, therefore liver helps to keep the body warm.

7. It makes fibrinogen and other blood proteins.

8. It decomposes the damaged red blood cells.

Pancreas:

It is a leaf like organ. It lies below the stomach and between the two arms of duodenum. The pancreas produces a juice which is called the pancreatic juice. This juice flows down the pancreatic duct into the duodenum. It contains three enzymes.

1. Pancreatic amylase which acts on undigested starches of the food and converts them into maltose.

2. Enzyme trypsin which breaks down proteins into peptides.

3. Lipase which splits fats into fatty acids and glycerol.

If any of the constituents of food still remain undigested, enzymes secreted by the glands in the small intestine act upon them and complete the digestion by converting peptides to amino acids, maltose and other sugars to glucose and fats to fatty acids and glycerol.

The enzymes secreted by the intestinal walls are amino-peptidases and disaccharidase,(which form glucose from maltose, lactose and sucrose). In this way food is completely digested at intestine.

Definition of Enzymes:

Enzymes are chemical compounds. They are protein in nature. They are formed in living cells. They are not consumed in a reaction but act as a catalyst as they only speed up the chemical reactions.

Types of Enzymes:

There are two types of enzymes:

1. Intracellular Enzymes

2. Extracellular Enzymes

Intracellular Enzymes

They work within a cell, in which they are produced.

Extracellular Enzymes

Some enzymes are secreted out of the cells where they work. They are called extracellular enzyme. Bacteria and fungi secrete such extra cellular enzymes into the medium in which they are growing. The higher organisms secrete extracellular enzymes into the lumen of alimentary canal to act on the food.

The enzymes acting on the starch are known as Amylases; those acting on proteins are known as Proteinases, while those acting on fats are known as Lipases.

The characteristics of enzymes are as follows:

1. All enzymes are protein in nature; they can be destroyed by heating.

2. They act best within a narrow, temperature range.

3. They work efficiently in narrow range of acidity or alkalinity.

4. A particular enzyme forms the same end-product, because it acts on a particular/specific substrate.

Light and Dark Reactions:

Light Reactions:

When light falls on the leaves, it is absorbed by chlorophyll. The solar energy is used to split water into oxygen and hydrogen and this is called photolysis (photo means light and lysis means to break). The oxygen is released into the atmosphere as by-product of photosynthesis. As this process takes place only in the presence of light, it is called light reaction.

During light reaction, two compounds are formed when the solar energy is converted into chemical energy these are:

1. NADPH (Nicotinamide Adenine Dinucleotide Phosphate)

2. ATP (Adenosine Triphosphate)

NADP, already exists in the cells of the leaf. The hydrogen released on the splitting of water molecule is accepted by this compound and it is reduced to NADPH.

ADP (Adenosine Diphosphate) is already present in the cell; it combines with the phosphate group using light energy to form a compound called ATP.

These compounds are energy rich compounds which are needed for the dark reactions of the process. Light reaction is called high dependent reaction.

Dark Reactions:

Using the energy of ATP and the NADPH, water combines with carbon dioxide to form carbohydrate. Thus the solar energy is now converted into chemical energy to form glucose. Other organic compounds are also synthesized from this glucose.

This stage is completed in a series of chemical reactions with the help of enzymes. Neither light energy nor chlorophyll is needed for dark reactions. Therefore dark reaction is also called light independent reaction.

Various steps of the dark reactions were studied by a scientist called Melvin Calvin so the dark reaction is also called the Calvin's Cycle.